

# Not the Last Word: Seers, Soothsayers, and Surgeons

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It was not until the 1940s could physicians reliably offer patients a better-than-even chance of being helped by what they prescribed. Before antibiotics, before diagnostic imaging, before the modern pharmacopoeia, most treatments were uncertain, some were inert, and more than a few were harmful. Yet patients sought out physicians, and physicians continued to matter.

Given medicine's lack of clinical effectiveness throughout most of that history, it is reasonable to wonder why.

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One easy answer is the provision of comfort. But a shaman can comfort, too, and maybe even more effectively. What medicine uniquely provided was something else: A disciplined account of what would happen next. In a word, prognosis.

Prognosis is, of course, more than a consolation prize in the absence of effective treatment. Prognosis is the basis for all treatment decisions. Every recommendation for surgery is, after all, based on comparative prognosis. Saying that surgery is indicated is merely another way of saying "I predict that the patient will do better with surgery above all else." And just as the stock picker's performance is benchmarked against the index, every well-indicated surgical intervention should outperform the trajectory of all other treatments or nontreatments. In both instances, without knowing the marginal difference, we cannot accurately assert that the intervention added value.

Nevertheless—even as treatments have improved, making comparative prognosis all the more important—my sense is that prognosis has lost its pride of place. Modern medicine has framed itself as a two-part enterprise: Dx and Rx. Diagnosis and treatment. We identify the disease, then we fix it. Prognosis, Px, has seemingly been demoted.

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The downplay of prognosis in orthopaedic surgery is ironic, given that pediatric orthopaedic surgery was built on the mastery of prognosis and orthopaedic surgery as a profession began with the care of children's musculoskeletal problems. Indeed, the word "orthopaedics" itself derives from the Greek words for "straight" (orthos) and "child" (paedion).

In pediatrics, the central question in a growing child is never simply what the disease is. Rather, it is a two-part inquiry: What is the disease and how will growth impact its course? Will a deformity resolve as the skeleton matures or will it worsen? That approach makes natural history an ineluctable part of the clinical calculus from the start.

Pediatric orthopaedics, one might say, learned about prognosis inadvertently. For most of history, the available treatments were slow, cumbersome, and dependent on adherence. Treatments were variations on the theme of Andry's tree, strapping the crooked sapling to a straight stake. Taking advantage of this, pediatric surgeons learned to interpret trajectories and they learned to distinguish the self-limited from the progressive. Prognosis is therefore not a supplement to the pediatric orthopaedic mindset. Prognosis *is* the mindset.

We need to borrow a page from the pediatric specialists and reinvigorate the study and application of prognosis in all forms of orthopaedic practice.

A prognosis renaissance will face obstacles, no doubt. The first

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impediment is ignorance: We simply have too many gaps in our knowledge base. Before you reject that claim, consider this thought experiment: Can you compose valid questions about prognosis suitable for an examination that features all the detail and specificity we uniformly include for diagnosis and treatment questions? For example, consider the femoral neck stress fracture. We can ask a resident to recognize it by patient history or on imaging. We can ask why stress fractures of the superior neck in particular warrant pinning (tension side, stress risers, and all that). But we cannot pose a board-style question about, say, the true risk of displacement without surgery. That is because we do not know the denominator—the number of patients who had this condition and never presented. The advice to pin a superior neck fracture—advice I have given and would follow myself!—rests on theory, not data.

Filling our knowledge gaps will be difficult. Natural history studies tend to produce conclusions that are commercially unrewarding. They are unlikely to generate intellectual property, attract industry partnerships, or deliver a career-making finding. Professional guilds also contribute to the diminution of the art of prognosis, owing to an understandable fondness for intervention over observation.

Despite all of this, I am optimistic that prognosis can regain its seat at the table. On the supply side, electronic medical records have made longitudinal clinical data abundant, and modern analytic methods can extract a signal from the noise. And this supply will be demanded: Third-party payers will insist on ever-better comparative standards, measuring treatments against both alternative methods and benign neglect alike. Beyond that, any shift from fee-for-service toward capitated

payment would further counteract the action bias that has skewed our understanding of some conditions.

Prognosis was what physicians offered before they could diagnose accurately or treat effectively. Prognosis was enough to sustain a profession for centuries. We should reclaim this domain, not as a lost art, but as the foundation it always was.

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As Dr. Bernstein so aptly identifies, the crux of pediatric orthopaedic surgery is prognosis—the art of projecting future adaptations by weighing natural history against intervention. We are in constant dialogue with the Hueter-Volkman principle, which states that compressive forces inhibit longitudinal growth while tensile forces stimulate growth [1], asking ourselves how the physis (growth plate) will respond over time. Will the physis adapt in our favor, as is the case in remodeling after a distal radius fracture, or will it progress toward worsening deformity, as is the case in scoliosis?

In this sense, prognosis may seem more relevant to orthopaedic surgeons who must contend with growth-related changes, but this is no different than a surgeon managing adults with musculoskeletal complaints who must contend with the prospect of long-term follow-up and aging. So why is prognostication so valued in pediatric orthopaedics and seemingly so discounted in other orthopaedic subspecialties?

One may posit that fee-for-service or “eat what you kill” compensation

plans have biased surgeons to offer surgical interventions more liberally, without critically analyzing the relative benefits of surgery in comparison to “watchful waiting” or nonoperative management. But this does not fully explain the prognostication differential between orthopaedic surgeons who treat children and those who treat adults. While pediatric orthopaedic surgeons are more likely to practice in an academic setting relative to other subspecialties, and are, therefore, likely to be more buffered from the pressure to intervene, most pediatric orthopaedic surgeons are, indeed, incentivized by relative value units (RVU) generation. As such, a revenue-related bias toward intervention probably isn't responsible for the difference between pediatric orthopaedic surgeons and other orthopaedic surgeons.

Yet, pediatric orthopaedic surgeons are, in large part, more likely to “play the long game”—to weigh natural history against intervention, and to provide more explicit explanations to patients and their families of what is likely to happen if nonintervention is chosen versus if surgery is pursued. I would like to think that pediatric orthopaedic surgeons, myself included, are wiser than other orthopaedic surgeons, but I am not foolish enough to believe this actually is true.

What sets us on the other side of the great prognostication divide are parents. Adult patients present to orthopaedic surgeons because they are seeking solutions to specific problems—they want to feel better, to *be* better, and often, they want it fast. Children, on the contrary, present with their parents or caregivers, who provide the needed doses of maturity, perspective, and patience when looking after their children that, ironically, they may lack when they are patients themselves. While some parents are as

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interested in a “fix” as their children, most parents whom I’ve worked with ask, “What if we do nothing? Do we really *need* surgery? What happens if you don’t operate? And what might happen over the long term if you *do*? What could go wrong?”

These parents are easy to chalk up as “worriers,” but isn’t that a parent’s most important role? By worrying about their children’s outcomes—their prognoses—the parents of my patients have forced me to analyze my own outcomes critically, and to dive deeper into the evidence so that I can answer their questions honestly. In this way, my patients’ parents and caregivers have been some of my most influential teachers. I would argue that all orthopaedic surgeons might benefit from practicing with that worried mom in the back of their minds, guiding them toward nuanced decision-making with an eye on prognosis.

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I disagree with Dr. Bernstein’s premise that prognosis has been demoted in modern medicine. Prognosis is fundamental to what we do. It is an art, informed by the wisdom garnered over a career, and it is precisely such wisdom that trainees seek when they choose their mentors and gravitate to a subspecialty. I maintain that the quest for understanding the sometimes elusive prognosis is very much alive and well in orthopaedic surgery.

Dr. Bernstein attests that when we recommend surgery, we are not predicting that the patient will do better with surgery above all else. I propose what, I believe, is a more

comprehensive view. We might recommend a particular intervention because we believe it will produce better outcomes than reasonable alternatives, including other procedures or non-operative management. The recommendation is therefore a comparative statement, not an absolute one, and our understanding of prognosis underpins it. Dr. Bernstein’s stock-picker analogy is apt and underscores the same point: The surgeon, like the investor, must benchmark every intervention against the alternative trajectory. The marginal difference is the prognostic question, and we are often equipped to answer it with externally validated tools.

As most orthopaedic surgeons know, arriving at a prognosis is not a one-size-fits-all exercise. We tune it to the individual, accounting for occupation, interests, support structure, and in some cases, insurance. This is the foundation of hundreds of Orthopaedic In-Training Examination questions that ask one to choose the best procedures for various patients, ranging from a sedentary individual to a laborer, all with the same radiographs. The calculus that informs the right answer is underpinned by evidence supporting—you guessed it—prognosis.

Until recently, this calculus was the exclusive province of experience. Rather than be demoted, prognosis has been promoted out of the bedside and into a methodologically rigorous, externally validated, guideline-endorsed enterprise that Dr. Bernstein’s essay does not address. The work to be done lies not in reclamation, but in fine-tuning our understanding by using the tools available to us. These tools are statistical in nature, requiring training, validation, and integration.

On the other hand, prognosis may be losing ground in subspecialties

driven by the tidy Dx-to-Tx pipeline: identify the problem, perform the procedure, collect the RVUs, repeat. The omission of prognostication from this pipeline breeds complacency because surgeons may not necessarily become invested in long-term outcomes. Moreover, it tends to reduce surgeons to mere technicians—which is exactly how payer policies seek to treat us.

Consider the trajectory: Mean Medicare reimbursement for orthopaedic procedures declined 26.2% from 2016 to 2024 [2]. Inflation-adjusted reimbursement for foot and ankle procedures fell 48% from 2000 to 2024, with the largest decrease (58.9%) applied to open reduction and internal fixation of the calcaneus [7]. The 2026 Medicare Physician Fee Schedule introduced a 2.5% efficiency cut for non-time-based procedures, justified by the contention that technology and workflow improvements have made them more efficient [3]. The signal is unambiguous: If a procedure becomes routine enough to be done by a robot or fast enough to fit a templated workflow, reimbursement will drop.

It would seem the only durable defense against this trajectory is the work that cannot be automated—the prognostic conversation, the personalization of the indication, and the integration of patient-specific evidence at the point of decision. To that end, prognosis is the surgeon’s economic moat.

Prognosis is, of course, central to pediatric orthopaedics and orthopaedic oncology. Both subspecialties confront natural history at the level of the individual patient and have built their decision-making frameworks around comparative trajectory rather than the procedure itself. The 2023 American Academy of Orthopaedic Surgeons Clinical Practice Guideline on metastatic carcinoma and myeloma of the femur [11] explicitly recommends that

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surgeons consider using a validated survival estimation tool before selecting a reconstruction strategy, and links survival ranges to specific surgical approaches. This is prognosis written into standard of care.

Dr. Bernstein invokes pediatric orthopaedic surgery as the model because pediatric orthopaedic surgeons learn prognosis inadvertently—growth, time, and the slowness of available treatments force them to reason longitudinally. This model, however, is not universal. Adult orthopaedic oncology, for instance, operates on the opposite timeline, because the patient with metastatic bone disease may have a trajectory that lasts only months. Treatment decisions must be made at a single visit, under genuine prognostic uncertainty. Our tools, therefore, look different. PATHFx and its peers compress longitudinal reasoning into a calibrated point estimate of survival at the point of care. This allows orthopaedic surgeons to minimize over- or undertreatment by tailoring treatment to each patient's estimated life expectancy. The pediatric orthopaedic surgeon studying a deformity over time and the oncologic surgeon consulting an externally validated decision support tool are doing much of the same thing, but on different timelines. Both involve a prognosis; neither is a demotion of the other.

Math may be helpful here. If the goal is to maximize net benefit to the patient, the equation is rooted in decision analysis—the framework that estimates the consequences of overtreatment and undertreatment and weighs them against their probabilities [10]. The orthopaedic evidence base is full of experiments that define what is considered over- or undertreatment: Sham-controlled trials of arthroscopic partial meniscectomy, subacromial decompression, and vertebroplasty are on the overtreatment side, while the

asymmetric thresholds that govern impending pathologic fracture and tension-sided femoral neck stress fracture are on the undertreatment side. The threshold for action is rarely symmetric, and the surgeon's job is to identify the asymmetry and counsel their patients accordingly. As such, prognosis is the operating system on which this decision tree runs.

Two decades ago, in a prospective study [8] of patients undergoing surgery for pathologic fractures at Memorial Sloan Kettering Cancer Center, the surgeon's estimate of survival was within 20% of actual survival in only 18% of patients. A more recent prospective study [6] came to a similar conclusion and extended it by showing that even a dedicated prognosis training program failed to improve it. New tools may help. One machine-learning model substantially outperformed medical oncologists' predictions of 3-month mortality [12]. The modern prognostic enterprise is not a demotion of a once-flourishing discipline; it is an evolution from mere expert opinion to data-driven clinical decision-making.

Dr. Bernstein offers the femoral neck stress fracture as the emblem of our prognostic ignorance. The narrow case is fair because we don't know as much as we would like to know about the natural history of nonsurgically managed stress fractures in young athletes or recruits. But in my view, and in those of the colleagues I polled in preparation for this commentary, the mere risk of completing a tension-sided femoral neck stress fracture is sufficient to warrant pinning. Far better to be safe than sorry.

Still, in the clinic, we almost always make decisions in the face of some uncertainty. Nonetheless, we do not need RCTs to answer every question. We know enough about the harms that displaced femoral neck fractures can

cause in young people to make sensible decisions. With those harms in mind, if my 23-year-old daughter, who is a Naval Officer, were to develop a tension-sided femoral neck stress fracture, I hope her hypothetical surgeon would pin it without delay. For those intent on running a randomized trial of pin-versus-observe, good luck, especially in the United States, where patients are far less likely to consent to randomization in the face of a known catastrophic downside risk. The decision threshold is so asymmetric that the trial is not only impractical, it is arguably unethical. And I believe it's unnecessary.

Dr. Bernstein closes with the call to reclaim prognosis as the foundation it always was. Instead, I argue that prognosis is not lost, does not need reclaiming, and is not principally a foundation; it is the dynamic construct of contemporary orthopaedic decision-making. The renaissance is not coming because it has already begun, having been fueled with contemporary data and the efficient means to make sense of it all. As the government seeks to reimburse us as technicians for some operations, we must resist this trajectory and retain our competitive advantage by rallying around the wisdom of prognosis.

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Dr. Bernstein offers an interesting proposal: to restore prognostication to the physician-patient interaction, which implies that prognosis has, to some extent, become a lost art. He says that, in the not-too-distant past, physicians and surgeons had little to offer patients beyond prognosis, since

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diagnostic accuracy was, at best, modest and most treatment options were ineffective or harmful. I would argue that while prognosis was a major feature of healthcare interaction in the past, enough therapeutic interventions helped to assure a positive reputation for learned physicians.

Physicians in ancient Egypt knew since 1500 BCE that an extract of the bulb-like corms of the toxic autumn crocus plant (*Colchicum autumnale*) could stop a gout attack [9]. Likewise, by the 1630s, the effect of Peruvian bark on relapsing fever (malaria) became common knowledge among European physicians, driving its price beyond that of gold or silver. The use of honey to prevent infections in open wounds was recorded in Sumerian cuneiform tablets from 2000 to 3000 BCE, as well as in later Egyptian papyri. Ointments containing honey still are recommended by knowledgeable wound-care experts today.

Many successful invasive and manipulative procedures have long been part of the medical armamentarium, including Caesarian section, lithotomy for bladder stones, reduction and immobilization of fractures and dislocations, amputation to prevent and treat limb sepsis, trephination for subdural hematoma, and bloodletting for dropsy (congestive heart failure). Unfortunately, inappropriately expanded indications and septic complications for many such procedures earned them a bad reputation.

Likewise, because of ignorance about physiology and microbial pathogenesis, mankind was long burdened by questionable theories of disease causation, including the four-humor concept, three-dosha ayurvedic principle, ying-yang balance, meridians, auras, and spinal subluxations, among others. These notions should, by now, inhabit the dustbin of history, yet some

persist, often to the detriment of ill individuals.

As for prognostication, we physicians universally understand implied prognosis when we offer a therapeutic intervention. We don't necessarily spell out the unfavorable outcome we're trying to prevent, but such thoughts always linger in the recesses of our minds. In this regard, I do agree with Dr. Bernstein that we should, perhaps, offer a clearer picture of our thought processes to our patients, but with some caveats. I'll use an experience of my own to explain what I mean.

Years ago, as part of a project to assess patient preferences in fracture care, I created a questionnaire that offered trade-off choices from a variety of outcomes in trauma care [5]. During the course of interviewing patients for the project, I asked each one, "Did your surgeon warn you of the possibility of infection as a result of your injury or treatment?"

"Oh, yes," was the inevitable reply, confirming the surgeon's "indications" preamble in the operative report.

"What was your understanding of the word *infection*?" I would ask next.

Half the patients said, "A pimple," and the other half said, "Like a cold." And then they all added, "I never expected anything like this," pointing to their draining wound, often with exposed hardware or bone.

I concluded that, during our half-decade of orthopaedic training, we learn a new vocabulary—one that often uses common words in specific, uncommon ways. For instance, how many of us have told our patients that their recent x-ray reveals "a fracture," only to hear them reply, "Good, at least it's not broken"?

Built into this vocabulary is a sense of prognosis that we often fail to convey to our patients. For instance, a 1% infection risk applied to the 4 million

total hip and knee arthroplasties performed each year means that 40,000 Americans will experience a prosthetic joint infection annually, almost all of whom will have one or more unplanned major operations. We all know this, but perhaps we don't convey it to our patients as vividly as we should. In this sense, we are either intentionally or unintentionally hiding the true prognosis. Dr. Bernstein refers to this phenomenon as the "downplay of prognosis in orthopaedic surgery."

Nevertheless, Dr. Bernstein is "optimistic that prognosis can regain its seat at the table." I, for one, am not so optimistic. Accurate prognosis—especially about the potential for unfavorable surgical outcomes—risks projecting a sense of insecurity to our patients in ways that might make both surgeon and patient uncomfortable. At some level, we're uneasy coming across as lacking in self-confidence, since we want our patients to believe we can deliver the hoped-for result. Two decades ago, in an article comparing surgeons and shamans [4], I analyzed the placebo value of ritual, especially in pain-relieving interventions. To achieve maximum benefit for the patient, I asserted that both the surgeon and the shaman must project faith that his or her ministrations will favorably influence the outcome. Realistic prognostication, although honest, may break the spell induced by self-assurance, compromising results to the detriment of both subject and practitioner. In this respect, total honesty may not always be the best policy. Prognosis, especially about treatment outcomes, has not been lost; it became, and will likely remain, hidden from full view.

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